

# Request Request Request Request Request Request Request



## PCI-SIG ENGINEERING CHANGE REQUEST

<b>TITLE:</b>	OCuLink Performance Table Change Rev 1.6
<b>DATE:</b>	November 17, 2017
<b>AFFECTED DOCUMENT:</b>	OCuLink 1.0
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### **Part I:**

#### **1. Summary of the Functional Changes**

This is a modification of the connector/cable performance tables defined in OCuLink 1.0, Section 6.9. The tables are reorganized to make this section of OCuLink more functional to the end user.

#### **2. Benefits as a Result of the Changes**

The proposed changes clarify connector/cable requirements for mechanical, environmental and electrical performance. References to the requisite EIA test standards have been added in order to clarify the test requirements. Descriptions of the EIA test standards have also been added to link performance requirements directly to EIA test procedures.

#### **3. Assessment of the Impact**

Details regarding performance validation of OCuLink connectors and cables have been clarified to eliminate any misinterpretation of mechanical, environmental and electrical performance testing/ requirements.

#### **4. Analysis of the Hardware Implications**

Connectors and cables must adhere to the fully specified EIA testing procedures described in the following text.

#### **5. Analysis of the Software Implications**

None, this change does not affect software.

**Part II:** Changes are reflected in Section 6.9 and Section 6.9.1 with the addition of Section 6.9.2 (begins on the next page).

## 6.9 Performance Requirements for Connectors and Cables

~~This Specification conforms to the test sequences, as defined in *EIA-364 TS-1000*. It is recommended that the OCuLink Fixed (Board-side) and Free (Cable-side) connectors to be used in PCI Express Subsystems be tested in accordance with *EIA-364-1000-01*, using the appropriate test sequences.~~

The OCuLink Fixed (Board-side) and Free (Cable-side) connectors to be used in PCI Express Subsystems must satisfy the connector performance requirements summarized in Table 6-11 below. To satisfy these requirements, connectors must be tested in accordance with *EIA-364-1000A*, which is described in more detail in Section 6.9.1. Latching requirements for mated connector/cable pairs are described in Section 6.9.2.

**Table 6-11. Connector Performance Requirements**

<u>Parameters</u>	<u>Requirements</u>
<u>Physical/ Mechanical Requirements</u>	
<u>Plating Type</u>	<u>Noble or non-noble</u>
<u>Surface Treatment</u>	<u>Lubricated or non-lubricated</u>
<u>Lifetime Durability- Internal</u> <u>(see Note 1)</u>	<u>Client/Mobile: 250 mating cycles</u> <u>Enterprise: 250 mating cycles</u>
<u>Lifetime Durability- External</u> <u>(see Note 1)</u>	<u>Client/Mobile: 10,000 mating cycles</u> <u>Enterprise: 250 mating cycles</u>
<u>Environmental Requirements</u>	
<u>Field Life- Enterprise (see Note 2)</u>	<u>5 years</u>
<u>Field Life- Client/Mobile (see Note 2)</u>	<u>3 years</u>
<u>Field Operating Temperature- Internal</u> <u>(see Note 3)</u>	<u>Client/Mobile: 25°C to + 60°C</u> <u>Enterprise: 25°C to + 65°C</u>
<u>Field Operating Temperature- External</u> <u>(see Note 3)</u>	<u>Client/Mobile: 25°C to + 55°C</u> <u>Enterprise: 25°C to + 65°C</u>
<u>Storage Temperature (see Note 4)</u>	<u>-40°C to + 85°C</u>

Notes:

1. Lifetime durability is the number of mate/un-mate cycles a connector is expected to endure in the field over the course of its lifetime. The number of durability cycles to which a connector is subjected during *EIA-364-1000A* test sequencing is dictated by the lifetime durability requirements listed above.
2. Field life requirements are used to determine exposure time for mixed flowing gas testing performed during *EIA-364-1000A* Test Group 4 sequencing.
3. Field operating temperature is used to determine the test temperature and duration for temperature life testing performed during *EIA-364-1000A* testing for Test Groups 1, 3 and 4.
4. The ability for product to withstand the specified permissible storage temperatures is confirmed by successfully passing the thermal shock testing performed during *EIA-364-1000A* Test Group 2 sequencing.

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## 6.9.1. ~~Current and Voltage Requirements~~ Connector Test Requirements

~~The current and voltage requirements are defined in ANSI/EIA-364-70.~~

In order for OCuLink connectors to be in compliance with *EIA-364-1000A*, Test Groups 1, 2, 3, 4 and 7 must be assessed. Table 6-12 summarizes the sequencing required for each of these test groups. Consult *EIA-364-1000A* for test specifics.

NOTE: The following table summarizes information for noble-plated, non-lubricated connectors and cables. If non-noble plating or lubricated connectors are to be tested, some of the EIA test groups may require substitution. Consult *EIA-364-1000A* for specific requirements.

**Table 6-12. EIA-364-1000A Test Sequences for Test Groups 1, 2, 3, 4 and 7**

<u>Test (see Note 1)</u>	<u>Test Group</u>				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>7</u>
<u>Low Level Contact Resistance</u>	<u>1, 4, 6</u>	<u>1, 4, 6, 8</u>	<u>1, 4, 6</u>	<u>1, 4, 6, 8, 10</u>	<u>2, 4</u>
<u>Durability (preconditioning)</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	
<u>Temperature Life</u>	<u>3</u>				
<u>Reseating</u>	<u>5</u>	<u>7</u>		<u>9</u>	
<u>Thermal Shock</u>		<u>3</u>			
<u>Cyclic Temperature and Humidity</u>		<u>5</u>			
<u>Temperature Life (preconditioning)</u>			<u>3</u>	<u>3</u>	
<u>Vibration</u>			<u>5</u>		
<u>Mixed Flowing Gas</u>				<u>5</u>	
<u>Thermal Cycling (disturbance)</u>				<u>7</u>	
<u>Dielectric Withstanding Voltage</u>					<u>1, 5</u>
<u>Durability</u>					<u>3</u>
<u>Notes:</u>					
<u>1. Intermediate LLCR measurements may be taken during any test sequence at the discretion of the tester, but are not required.</u>					

The following table summarizes details for the tests required by *EIA-364-1000A*. Several of these test procedures are dependent on OCuLink performance requirements, which are listed in Table 6-11. Procedures that are dependent on performance requirements are denoted as such.

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**Table 6-13. EIA-364-1000A Test Details**

<u>Test</u>	<u>Test Procedure</u>	<u>Test Criteria</u>
<u>Durability (preconditioned)</u>	<u>See Note 1</u>	<u>No intermediate requirements during <i>EIA-364-1000A</i> testing</u>
<u>Durability</u>	<u>Cycle rate: 200 cycles/ hour (see Notes 1 &amp; 2)</u>	
<u>Mixed Flowing Gas</u>	<u>Class IIA (see Note 3)</u>	
<u>Temperature Life</u>	<u>See Note 4</u>	
<u>Cyclic Temperature and Humidity</u>	<u>Follow test procedures as defined by <i>EIA-364-1000A</i></u>	
<u>Reseating</u>		
<u>Thermal Shock</u>		
<u>Thermal Cycling (disturbance)</u>		
<u>Low Level Contact Resistance</u>		
<u>Vibration</u>		<u>Maximum 20 mΩ deviation from baseline for Groups 1 through 4; maximum 50 mΩ deviation from baseline for Group 7 (see Note 5)</u>
		<u>No electrical discontinuity longer than 1 microsecond throughout test duration</u>
<u>Dielectric Withstanding Voltage</u>	<u>Method A, Test Condition I</u> <u>250 VDC minimum for 100 ms</u>	<u>No defect or breakdown between adjacent contacts</u> <u>-and-</u> <u>No current leakage in excess of 5mA</u>

**Notes:**

1. The number of durability cycles tested during EIA sequencing is dependent on the number of durability cycles a connector is expected to endure over the course of its lifetime. Lifetime durability requirements for OCuLink connectors are listed in Table 6-11. Refer to EIA-364-1000A for the corresponding number of cycles required during EIA testing.
2. For connectors with passive latches, perform durability testing with latches engaged. For connectors with active latches, perform durability testing with latches disabled.
3. Exposure times for mixed flowing gas testing are determined by the field life requirements list in Table 6-11; refer to Table 4.1 in EIA-364-1000A for corresponding exposure times. Test mated and unmated connectors per EIA-364-1000A Option 2.
4. Test temperature and duration for temperature life testing are determined by field operating temperature and field life requirements listed in Table 6-11. For test temperature and duration, refer to EIA-364-1000A for testing of non-preconditioned and preconditioned samples, respectively.
5. Measurements are taken across mated contacts. Baseline measurements are established during the first low level contact resistance (LLCR) measurement for each EIA test group. There are no restrictions on baseline measurements. Subsequent LLCR measurements within a given group must be within the specified deviation from the baseline measurement for that group.

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In addition to [EIA-364-1000A](#) requirements, OcuLink requires compliance with several supplementary tests. These tests are to be conducted outside of [EIA-364-1000A](#) test sequencing. Connectors must satisfy the supplementary tests listed in Table 6-14.

**Table 6-14. Supplementary Connector Test Details**

<a href="#">Test</a>	<a href="#">Test Procedure</a>	<a href="#">Test Criteria</a>
<a href="#">Current</a>	<a href="#">EIA-364-70</a> <a href="#">Method 3: 30°C maximum temperature rise</a>	<a href="#">All contacts 0.5A per contact maximum</a> <b>-except-</b> <a href="#">The two 5 V pins to be 1A per contact maximum</a>
<a href="#">Insulation Resistance</a> <a href="#">(see Note 1)</a>	<a href="#">EIA-364-21</a> <a href="#">100 mVDC</a>	<a href="#">100 MΩ minimum between adjacent contacts (unmated)</a>
<a href="#">Mechanical Shock</a>	<a href="#">EIA-364-27</a> <a href="#">Test Condition A</a>	<a href="#">No chips, cracks or fractures visible at 10x magnification</a> <b>-and-</b> <a href="#">No electrical discontinuity longer than 1 microsecond throughout test duration</a>
<a href="#">Notes:</a> <a href="#">1. The minimum Hi-Pot requirement for cable assemblies is determined in part by this test.</a>		

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~~Table 6-11. Connector Electrical Requirements~~

Description	Requirement	Procedure
Contact Continuous Current-Carrying Capability	All contacts 0.5 A per contact MAX. <del>—except—</del> The two 5 V pins to be 1 A per contact MAX.	<del>30 °C maximum temperature rise</del>
Voltage	30 VDC per contact	
Low Level Contact Resistance	Baseline	20 mVDC, 10 mA <del>EIA-364-23</del>
Insulation Resistance (Note 1)	100 MΩ minimum between adjacent contacts (unmated).	100 VDC
Dielectric Withstanding Voltage (Note 1)	No defect or breakdown between adjacent contacts.	250 VDC minimum for 100 ms
Notes:		
1. The minimum Hi-Pot requirement for cable assemblies is determined by the Insulation Resistance and the Dielectric withstanding Voltage.		

~~Table 6-12. Connector Environmental Requirements~~

Description	Requirement
Field Life	<del>3 years</del>
Field Operating Temperature—External	<del>-25 °C ~ +55 °C</del>
Field Operating Temperature—Internal	<del>-25 °C ~ +60 °C</del>
Test Group 4 Option	<del>1B</del>
Storage Temperature	<del>-40 °C to +85 °C</del>
Storage Humidity	<del>80 % Relative Humidity</del>

~~Table 6-13. Connector Mechanical Requirements~~

Description	Requirement	Procedure
Contact Interface Plating Type	Noble	
Surface Treatment (Lubricated or non-Lubricated)	Specified by Manufacturer	
Rated Durability Cycles—External	10,000	
Rated Durability Cycles—Internal	50	
Vibration	No Damage. No discontinuity longer than 1 microsecond allowed. 30 mΩ maximum change from initial (baseline) contact resistance.	<del>EIA-364-28</del> Condition III
Mechanical Shock	No Damage. No discontinuity longer than one microsecond allowed. 30 mΩ maximum change from initial (baseline) contact resistance.	<del>EIA-364-27</del> Condition A

6.9.2      Supplementary Connector/ Cable Test Requirements

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**Table 6-14. ~~Connector/Cable Latching Requirements~~**

Description	Min	Max	Units	Conditions / Comments
Mating Force				Rate 19-31 mm/s <i>EIA-364-13</i>
<del>–Connector (w/out latch)</del>	<del>2</del>	<del>20</del>	<del>N</del>	
<del>–Connector W/ Passive Latch</del>	<del>10</del>	<del>40</del>	<del>N</del>	
<del>–Connector W/Active Latch</del>	<del>8</del>	<del>40</del>	<del>N</del>	
Un-Mating Force				Rate 19-31 mm/s <i>EIA-364-13</i>
<del>–Connector (w/out latch)</del>	<del>1</del>	<del>16</del>	<del>N</del>	
<del>–Connector W/ Passive Latch</del>	<del>8</del>	<del>25</del>	<del>N</del>	
<del>–Connector W/Active Latch W/Pull</del>	<del>8</del>	<del>25</del>	<del>N</del>	
Wrenching Strength W/ Mated Cable – Passive Latch		25	N	Bend cable 90-degrees at minimum bend radius. Pull in 4 axis directions for round cable. Pull in 2 axis directions for flat cable. No damage to plug/cable assembly.
Wrenching Strength W/ Mated Cable – Active Latch		40	N	Bend cable 90-degrees at minimum bend radius. Pull in 4 axis directions for round cable. Pull in 2 axis directions for flat cable. No damage to plug/cable assembly.
Active Latch Retention Strength	30		N	No damage to plug/cable assembly below Minimum Value

[Table 6-15 below lists mating force requirements for OCuLink connectors and cables.](#)

**Table 6-15. Additional Connector/Cable Requirements**

<u>Parameter</u>	<u>Variations</u>	<u>Test Criteria</u>	
		<u>Minimum [N]</u>	<u>Maximum [N]</u>
<a href="#">Mating forces</a> <a href="#">(see Notes 1 &amp; 2)</a>	<a href="#">Passive latch</a>	<a href="#">2</a>	<a href="#">25</a>
	<a href="#">Active latch</a>		
<a href="#">Un-mating forces</a> <a href="#">(see Note 1)</a>	<a href="#">Passive latch</a>	<a href="#">8</a>	<a href="#">25</a>
	<a href="#">Active latch</a>		
<a href="#">Latch retention force</a>	<a href="#">Active latch (see Note 3)</a>	<a href="#">30</a>	
<a href="#">Wrenching force</a>	<a href="#">External cables only (see Note 4)</a>	<a href="#">7</a>	

**Notes:**

1. These tests are to be conducted per *EIA-364-13*. Both the fixed shell and the cable housing must be free

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of apparent deformation after testing.

2. Latches must be engaged during testing.

3. This test is to be conducted per EIA-364-38 Method A using a 30N load applied at a rate of 30N/ minute with the active latch engaged. The full 30N load must be applied for a minimum of 10 seconds. The distance between the front of the connector and the active latch retention point (dimension N02) must be within the allotted range (refer to Table 6-8) both before and after completion of the test. Additionally, the latch must remain intact, meaning the connector must remain mated throughout the duration of the test and there can be no distortion or bending of the metal parts of the connector. No maximum retention force is defined.

4. Wrenching force test is to be conducted as follows:

Mount receptacle connector to a board at least 0.8 thick. Clamp the board no further than 5mm away from the receptacle. Mate cable to be tested. Apply a load greater than or equal to the force specified above to the bulk cable no more than 12 inches away from the cable exit for 10 seconds. For round cables, apply force in each of 4 major axis directions perpendicular to the cable exit direction (i.e. up, down, left, right). For flat cables, apply force in two major axis directions perpendicular to the cable exit direction along the cable's minimum bend radius (i.e. up, down). Monitor electrical continuity throughout testing per EIA-364-46. If an electrical discontinuity greater than 1 microsecond or any physical damage to the connector interface and/or latching mechanism occurs, wrenching requirements are not met.